

CLAIMS

1           1. A liquid receptacle for rapidly lowering the temperature of a liquid  
2           contained therein to a warm range suitable for human contact and maintaining the  
3           liquid in the warm range for an extended period of time, said receptacle  
4           comprising:

5                 an inner vessel having an open upper end and closed lower end and a wall  
6           connecting said upper end and said lower end;

7                 an insulated outer shell spaced from said inner vessel defining an  
8           interstitial chamber therebetween; and

9                 a phase change material disposed within said chamber for regeneratively  
10          absorbing thermal energy from the liquid and then releasing the thermal energy to  
11          the liquid to maintain the temperature of the liquid.

1           2. A receptacle according to claim 1 wherein said outer shell has an inner  
2           surface and an outer surface; and

3                 said upper end of said inner vessel is in sealing engagement with said inner  
4           surface of said outer wall.

1           3. A receptacle according to claim 1 wherein said inner vessel is formed  
2           from a material having a thermal conductivity greater than 150 Watts/meter-degree  
3           Kelvin.

1           4. A receptacle according to claim 3 wherein said material is selected from  
2           the group consisting of aluminum, aluminum alloys, copper, and copper alloys.

1           5. A receptacle according to claim 1 wherein said outer shell comprises  
2           an inner layer and an outer layer with an evacuated void therebetween for vacuum  
3           insulating said outer shell.

1           6. A receptacle according to claim 1 wherein said outer shell comprises  
2 a layer of insulating foam.

1           7. A receptacle according to claim 6 wherein said foam is selected from  
2 a group consisting of polyurethane and polystyrene.

1           8. A receptacle according to claim 1 wherein said outer shell is plastic.

1           9. A receptacle according to claim 1 wherein said outer shell is stainless  
2 steel.

1           10. A receptacle according to claim 1 wherein said phase change material  
2 has a solid to liquid phase change temperature within the range of 110 degrees  
3 Fahrenheit to 160 degrees Fahrenheit.

1           11. A receptacle according to claim 10 wherein said phase change material  
2 is selected from the group consisting of naturally occurring fatty acids.

1           12. A receptacle according to claim 1 wherein said phase change material  
2 is palmitic acid.

1           13. A receptacle according to claim 1 wherein said receptacle is a mug for  
2 receiving a hot beverage.

1           14. A receptacle according to claim 1 wherein said receptacle is a baby  
2 bottle.

1           15. A receptacle according to claim 1 wherein said receptacle is a carafe.

1           16. A receptacle according to claim 1 wherein said receptacle is a bath  
2   tub.

1           17. A liquid receptacle for rapidly lowering the temperature of a hot  
2   beverage contained therein to a warm range suitable for human consumption and  
3   maintaining the liquid in the warm range for an extended period of time, said  
4   receptacle comprising:

5           an inner vessel having an open upper end and closed lower end and a wall  
6   connecting said upper end and said lower end;

7           an insulated outer shell spaced from said inner vessel defining an  
8   interstitial chamber therebetween;

9           said outer shell having an inner surface and an outer surface and an upper  
10   edge terminating in a lip for drinking;

11          said upper end of said inner vessel being in sealing engagement with said  
12   inner surface of said outer shell and spaced from said lip for preventing contact  
13   between said inner vessel and the mouth of a consumer of liquid from said  
14   receptacle; and

15          a phase change material disposed within said chamber for regeneratively  
16   absorbing thermal energy from the beverage and then releasing the thermal energy  
17   to the beverage to maintain the temperature of the liquid.

1           18. A receptacle according to claim 17 wherein said upper end of said  
2   inner vessel is spaced from said lip by a distance greater than .125 inches.

1           19. A receptacle for bathing comprising:

2           an inner vessel having an inner surface and an outer surface;

3           a container contacting said outer surface and in thermally conductive  
4   communication with said inner surface; and

5           phase change material disposed within said container.

1           20. A receptacle according to claim 19 wherein said container is insulated  
2           for preventing heat loss to the atmosphere.

1           21. A receptacle according to claim 19 wherein said container is  
2           removably attached to said outer surface for removal and replacement of said  
3           container.

1           22. A method of rapidly cooling a hot liquid to a temperature within a  
2           warm range suitable for human contact and maintaining the liquid in the warm  
3           range for an extended period of time comprising the steps of:

4           a) conducting thermal energy from the hot liquid through a thermally  
5           conductive layer and into a chamber containing a phase change material;

6           b) absorbing the thermal energy into the phase change material thereby  
7           converting the phase change material from a solid state to a liquid state until the  
8           liquid and the phase change material are substantially at equilibrium; and

9           c) releasing thermal energy from the phase change material and  
10          conducting the thermal energy into the liquid thereby supporting the temperature  
11          of the liquid and converting the phase change material from the liquid state to the  
12          solid state.

1           23. A method of making a liquid receptacle comprising the steps of:

2           a) molding a plastic outer shell;

3           b) stamping an inner receptacle from a material selected from a group  
4           comprising aluminum, aluminum alloys, copper, and copper alloys;

5           c) injecting uncured liquid foam into the outer shell;

6           d) inserting a die into the outer shell thereby forming the foam into a layer  
7           between the outer shell and the die;

8           e) allowing the liquid foam to cure into a solid foam creating a foam lined  
9           outer shell;

10          f) removing the die;

- 11           g) melting a phase change material by raising the temperature of the
- 12 material above the solid to liquid phase change temperature;
- 13           h) injecting the phase change material into the foam lined outer shell;
- 14           i) inserting the inner receptacle into the outer shell so that the receptacle
- 15 is sealed to the outer shell and the inner receptacle is spaced from the outer shell
- 16 defining an interstitial chamber
- 17 containing the phase change material.